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10/685,675	10/14/2003	Helen Zhu	P-1058-LAM-Rao	7054

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EXAMINER	
NGUYEN, THANH T	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 11/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 10/685,675	**Applicant(s)** ZHU ET AL.	
	Examiner Thanh T. Nguyen	**Art Unit** 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *9/14/04*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-15* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date [illegible].
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1-15 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-13 are rejected under 35 U.S.C. 102(e) as being anticipated by Ma et al. (U.S. Patent No. 6,485,988).

Referring to figures 4a-4d, Ma et al. teaches a method of etching an integrated circuit (IC) structure having an etched dielectric material (408) with an exposed barrier layer (402/404/406, silicon nitride, see col. 22, lines 1-3); wherein the barrier layer is composed of a material consisting essentially of silicon nitride (see col. 22, lines 1-3), the method comprising:

Feeding a nitrous oxide (N_2O) gas and a fluoromethane (CH_3F) gas into a reactor (see col. 22, lines 1-30);

Generating a plasma (see col. 22, lines 1-30) in the reactor;

Etching the barrier layer (see col. 22, lines 1-30); and

Generating a high selectivity between the barrier layer (see col. 23, lines 19-25) to the dielectric material (408).

Regarding to claim 2, the dielectric material is comprised of materials that include silicon and oxygen (408, see col. 22, lines 31-41).

Regarding to claims 3, 7, the selective of the silicon nitride barrier layer to the etched dielectric layer is 1.7 or more (see col. 23, lines 19-25, selectivity is greater than 5)

Regarding to claims 4, 8, 12, etched dielectric material is composed of a material selected from a group consisting of silicon dioxide, silicon oxide, organosilicate glass, SiLK, and fluorinated silicate glass (408, see col. 22, lines 31-41).

Regarding to claims 5, 9, 13, 15, depositing a thin barrier layer over the IC structure (430, see fig. 4d, col. 25, lines 5-14).

Regarding to claim 6, etching an integrated circuit (IC) structure having an etched dielectric material (408) with an exposed barrier layer (402/404/406, silicon nitride, see col. 22, lines 1-3), wherein the barrier layer is composed of a material consisting essentially of silicon nitride (see col. 22, lines 1-3), and a third layer having a copper interconnect (432), the barrier layer (430, see col. 22, lines 5-14) between the etched first dielectric layer (408) and the third layer (432), comprising limiting oxidation of the third copper interconnect (432). It is held, absent evidence to the contrary that nitrous oxide (see col. 22, lines 1-30) would limiting the oxidation of the copper. *See* In re Best, 195 USPQ 428 (CCPA 1977) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980).

Regarding to claim 10, etching an integrated circuit (IC) structure having a via etched (114) into a first dielectric layer composed of a first dielectric material (112), a second barrier layer (402/404/406) wherein the barrier layer is composed of a material consisting essentially of silicon nitride (see col. 22, lines 1-3), and third layer having a conductive interconnect (432), the etched second dielectric layer (408) and a third layer (432) comprising: generating a high selectivity between the barrier layer (see col. 23, lines 19-25) to the first dielectric material (408); and limiting oxidation of the third copper interconnect (19). It is held, absent evidence to the contrary that nitrous oxide (see col. 22, lines 1-30) would limiting the oxidation of the copper. *See* In re Best, 195 USPQ 428 (CCPA 1977) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 14-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al. (U.S. Patent No. 6,485,988) as applied to claims 1-13 in view of Cooney, III et al. further in view of Biolsi et al. (U.S. Patent No. 6,677,678).

Referring to figures 4a-4d, Ma et al. teaches etching an integrated circuit (IC) structure having a via etched (114) into a first dielectric layer composed of a first dielectric material (112), a second barrier layer (402/404/406) wherein the barrier layer is composed of a material consisting essentially of silicon nitride (see col. 22, lines 1-3), and third layer having a conductive interconnect (432), the etched second dielectric layer (408) and a third layer (432) comprising: generating a high selectivity between the barrier layer (see col. 23, lines 19-25) to the first dielectric material (408); and limiting oxidation of the third copper interconnect (19).

However, the reference does not teach the conductive interconnect are misaligned, and during the etching of the silicon nitride barrier layer, the second dielectric material is partially etched and a cavity is formed in the second dielectric layer.

Cooney, III et al. teaches forming the conductive interconnect (see col. 7, lines 16-18) are misaligned (see figure 5), the second dielectric material is partially etched and a cavity (50) is formed in the second dielectric layer (54)

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made form the conductive interconnect are misaligned, the second dielectric material is partially etched and a cavity is formed in the second dielectric layer in process of Ma et al. as taught Cooney, III et al. because the conductive interconnect are misaligned, the second dielectric material is partially etched and a cavity is formed in the second dielectric layer would preventing degradation in metal wiring lines and metallization interconnect feature, considerable cost savings are achieved due to lowered failure rates and degradation monitor.

Biolsi et al. teaches a forming a barrier layer (11, silicon nitride/carbide, see col. 4, and lines 57-60), forming a dielectric layer (12, silicon oxide, see col. 4, lines 61-67), forming an opening (20/24), wherein via (24) and the conductive interconnect (8) are misaligned (see figure 11) and during the etching of the silicon nitride barrier layer (11).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form the barrier by using silicon nitride or silicon carbide, the conductive interconnect are misaligned, and during the etching of the silicon nitride barrier layer in process Ma et al. as taught Biolsi et al. because forming the barrier by using silicon nitride or silicon carbide, the conductive interconnect are misaligned, and during the etching of the silicon nitride barrier layer would preventing copper diffusion during making a contact to interconnection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN